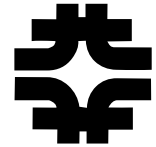


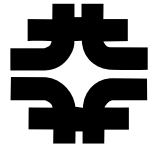
Run IIb of the Tevatron Collider

Director's Review

Michael Witherell

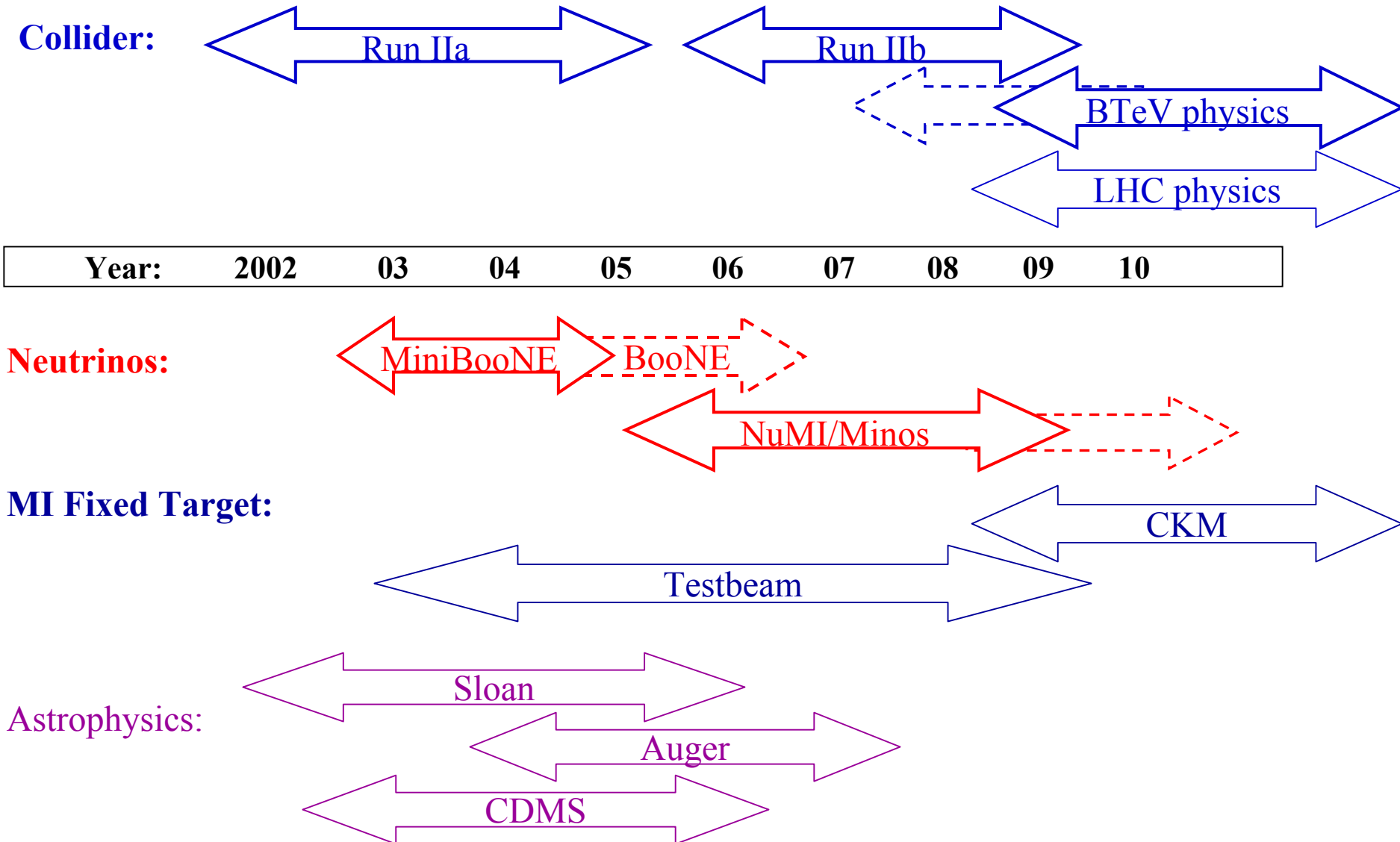
August 12, 2002

The Fermilab Program

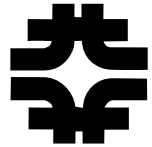


Program	Physicists	Primary Facilities
Tevatron	600 CDF, 600 D0	collider complex, detectors, computing farms
Neutrino	200 MINOS, 60 BooNE	neutrino beams, detectors
US-CMS	300	detector, computing, research home
US-LHC	600 US, 3000 other	accelerator systems
Astro	250 Auger, 45 CDMS	large detectors
	150 SDSS	telescope, data handling
Quark Flavor	150 BTeV, 60 CKM	accelerator complex, detectors
Lattice Gauge	60	commodity cluster facility

Fermilab Research Program



The Tevatron Collider Program



The Collider Run II is the most important activity at Fermilab.

- The only collider able to address the physics of the highest energy scale in the period 2002 to 2007

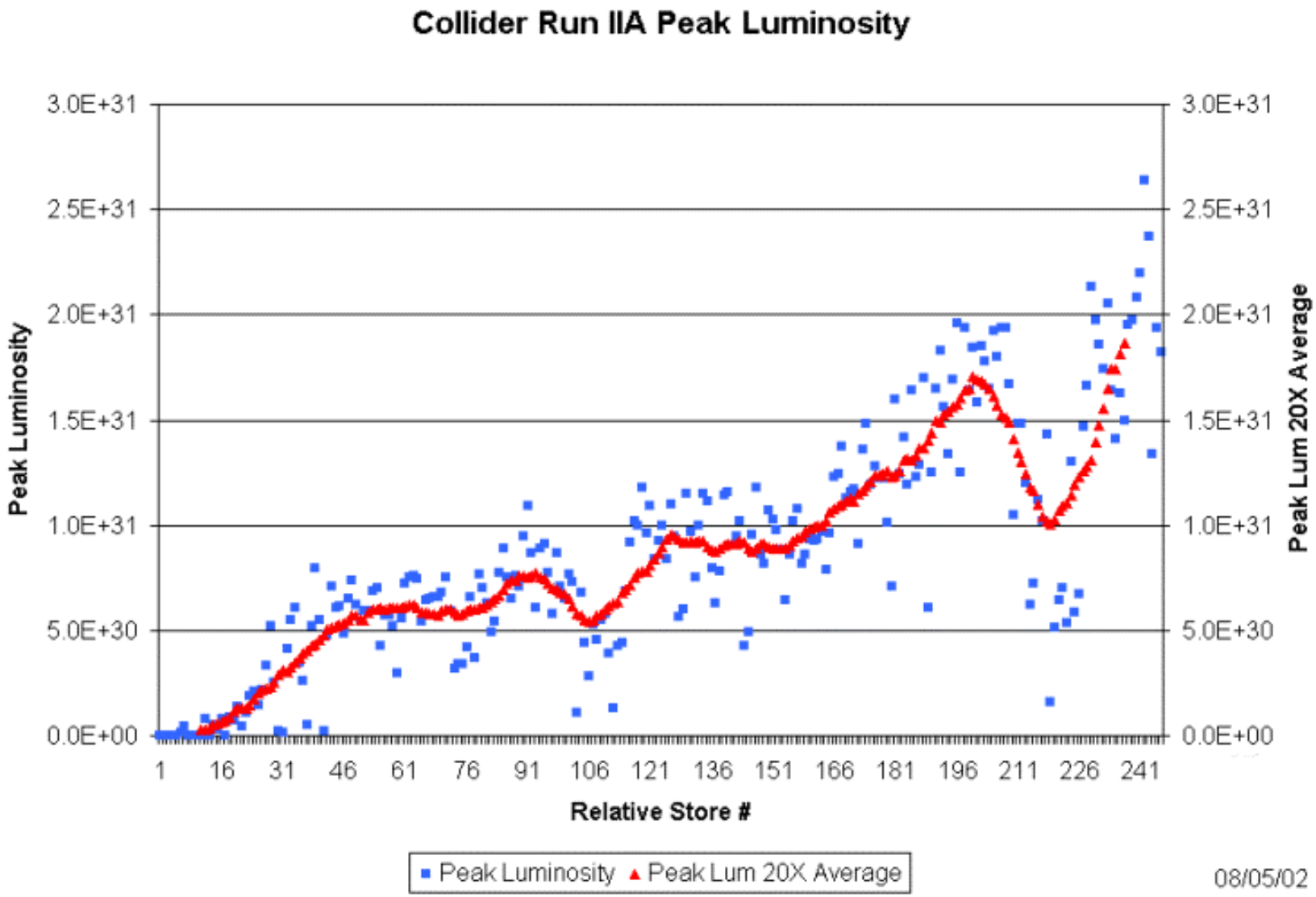
- Possible discoveries:
  - Higgs boson
  - Supersymmetry
  - Extra dimensions
  - New dynamics (technicolor, new gauge bosons)
  - Quark or lepton compositeness
- Precise measurements to confront the Standard Model:
  - top quark and W boson properties
  - measurements of B mixing and CP parameters

Run IIa Luminosity Goals

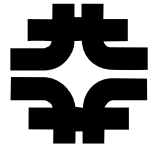
- Run IIa refers to operations supported by the collider configuration described in the Run II Handbook
  - For Run I: Typical peak luminosity was ~1.6×10^{31} cm^{-2} s^{-1}; Integrated luminosity was ~0.15 fb^{-1}.
  - The official luminosity goal for Run IIa was defined in the data sheet for the Main Injector Project:

    "The Tevatron proton-antiproton colliding beam luminosity will be increased to at least $5 \times 10^{31} cm^{-2} sec^{-1}$."
    - This would lead to an integrated luminosity ~2 fb^{-1}.
  - In addition, we are doing everything feasible to exceed those goals with additional effort and the Recycler. We believe the limits are
    - 8×10^{31} with the present configuration
    - 2×10^{32} with full benefit of the Recycler

Performance: Peak Luminosity

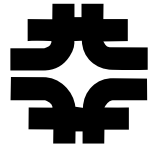


Collider status



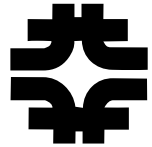
- Luminosity improvements
  - The record luminosity is 2.64E31.
  - We are pushing immediately toward 4E31 and putting more emphasis on integrating luminosity.
- Additional effort for Run II
  - We already had increased funding for Run II out of rest of laboratory.
  - We have brought in substantial effort from other Divisions.
  - We have coupled help from other laboratories into the effort.

Physics prospects in Run II



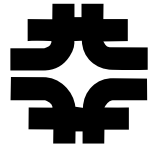
- Precise measurements, looking for cracks in the Standard Model:
  - top quark and W boson properties
  - measurements of B mixing and CP parameters
- Possible discoveries
  - Higgs boson
  - Supersymmetry
  - Extra dimensions
  - New dynamics (technicolor, new gauge bosons)
  - Quark or lepton compositeness
- The detectors are much improved over Run I, so each pb^{-1} is worth more. (3-4x more for top quark samples)
- Every factor-of-2 increase in the integrated luminosity makes possible a new round of important physics results.
- First results were presented at ICHEP 2002 in Amsterdam.

Run IIb



- Additional luminosity provides greater precision for electroweak measurements, greater reach for exotic searches, plus the opportunity to observe a low-mass Higgs boson.
- Accelerator
  - Improve luminosity by factor of 2-3 with a number of modest upgrades.
  - Right now, most attention is concentrated on run IIa, with some effort on long-leadtime items for IIb improvement subprojects
- Detectors
  - Two upgrade projects under review here
  - The goal is to keep the experiments operating effectively throughout Run II.

PAC at June meeting

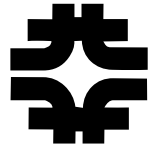


- Physics is compelling.
  - "Even non-observation of the Higgs in Run IIb would be a result of extreme importance. If the Higgs is not observed, 95% CL exclusion over the mass range required by the electroweak precision data would put the Standard Model in crisis."
- Upgrades are needed.
  - "Maintaining the capabilities of the CDF and D0 detectors throughout the run is … essential for the success of Run II."
- "The Committee recommends Stage I approval for the CDF and D0 Run IIb upgrade projects."

Run IIb Conditions

- The maximum luminosity that the collider will be able to deliver is ~$4 \times 10^{32} cm^{-2} s^{-1}$.
- There are two possible running conditions for Run IIb.
  - 396 ns bunch spacing.
    - Luminosity would be leveled at 2×10^{32} cm^{-2} s^{-1} to optimize detector performance.
    - Integrated luminosity would be the same as if no leveling and initial luminosity of ~ 3.4×10^{32} cm^{-2} s^{-1}.
    - The detectors should operate efficiently, with significant safety margin, at a luminosity of 2×10^{32} cm^{-2} s^{-1}.
  - 132 ns bunch spacing.
    - This is a secondary option, since the luminosity would be ~0.5x that available at 396 ns for the same number of antiprotons.
    - We preserve this option until the effective operation of luminosity leveling is established.

Summary



- We have great opportunities for discovery at the Tevatron collider.
- We are working to realize that opportunity.
- We are investing a massive effort to improve the luminosity continuously.
- We have worked hard with the CDF and D0 collaborations
  - to develop detector upgrades that will keep them operating efficiently throughout Run IIb and
  - to get the upgrade projects ready for approval of the baselines.